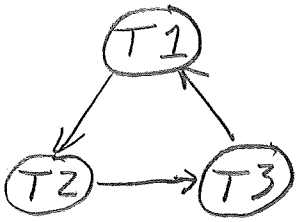
David Kalish
ps3_partI

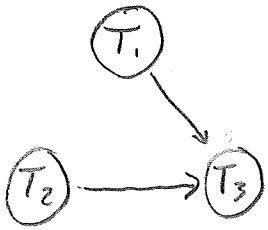
① Schedule 1:

$w_1(A)$; $r_2(A)$; $w_2(B)$; $r_3(B)$; $w_3(C)$; $r_1(C)$



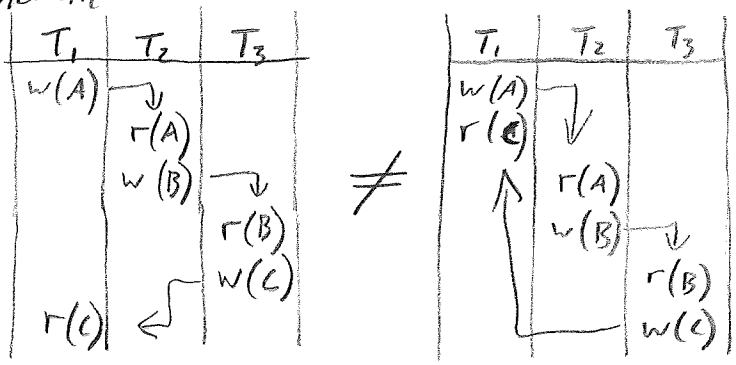
cyclic: not conflict serializable

Schedule 2: $r_1(C)$; $w_1(A)$; $r_3(A)$; $w_2(B)$; $r_3(B)$; $w_3(C)$



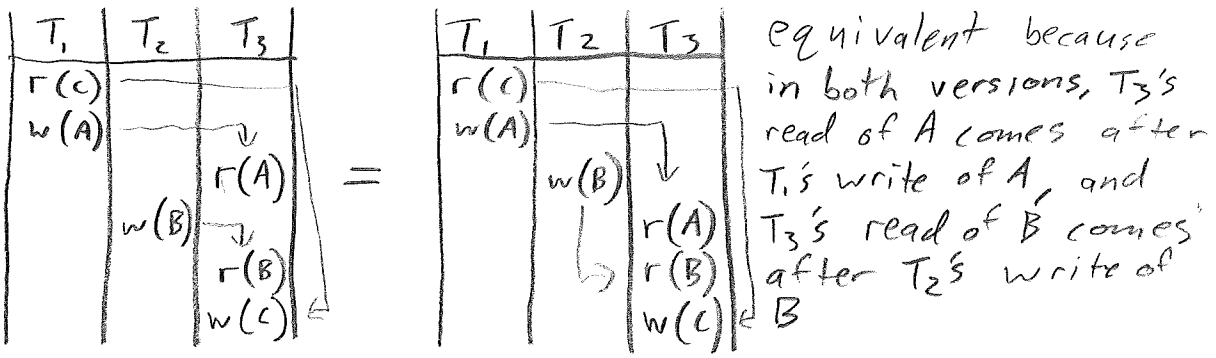
acyclic: conflict serializable

Schedule 1:



not equivalent because T_1's read of C needs to come after T_3's write of C. Now it comes before.

Schedule 2:



equivalent because in both versions, T_3's read of A comes after T_1's write of A, and T_3's read of B comes after T_2's write of B

(2) 2-phase locking

T_1: r(B) r(C) r(A) w(C) c

T_2: r(B) r(A) r(C) w(A) c

T_1	T_2
sl(B)	
r(B)	
	sl(B)
	r(B)
	xl(A)
	sl(C)
	u(B)
sl(C)	
r(C)	
	r(A)
	r(C)
	w(A)
	c
	u(A)
	u(C)
sl(A)	
xl(C)	
r(A)	
w(C)	
c	
u(A)	
u(B)	
u(C)	

2) not rigorous because T_2 unlocks B early

3) Not recoverable because T_1 does writes after T_2's commit. If system crashes after $w_1(C)$ but befor T_1 commits, T_2 will be restored while T_1 undoes changes.

4) recoverable version:

T_1	T_2
sl(B)	
r(B)	
	sl(B)
	r(B)
	xl(A)
	sl(C)
	u(B)
sl(C)	
r(C)	
	r(A)
	r(C)
	w(A)
	u(A)
	u(C)
sl(A)	
xl(C)	
r(A)	
w(C)	
u(A)	
u(B)	
u(C)	
	c
c	

5) not cascadeless because T_1's r(A) is a dirty read after T_2 writes A

③ Lock Modes

$xl_2(A)$ $w_2(A)$ $sl_1(B)$ $r_1(B)$ $ul_3(c)$ ...

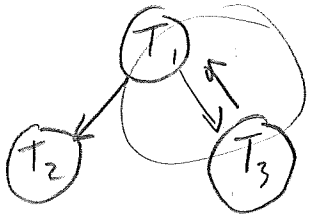
1) $ul_1(A)$ - no, A is under exclusive lock in T_2
2) $sl_3(B)$ - yes, B is under shared lock in T_1
3) $ul_2(B)$ - yes, B is shared lock in T_1
4) $sl_1(c)$ - no, C is update-locked in T_3
5) $xl_3(c)$ - yes, this upgrades T_3's update lock
6) $ul_2(c)$ - no, T_3 has C update locked, only 1 T can have an update lock of a given item at a time.

④ Deadlock Detection

seq 1: $r_2(c)$; $r_1(D)$; $w_1(c)$; $r_3(c)$; $w_2(c)$; $w_3(D)$; $w_1(D)$

T_1	T_2	T_3
	sl(c); r(c)	
sl(D); r(D)		
xl(c) DENIED wait for T_2		
		sl(c); r(c)
	xl(c); w(c)	
	commit	
	u(c)	
xl(c) DENIED wait for T_3		
		xl(D) DENIED wait for T_1

Waits-For Graph

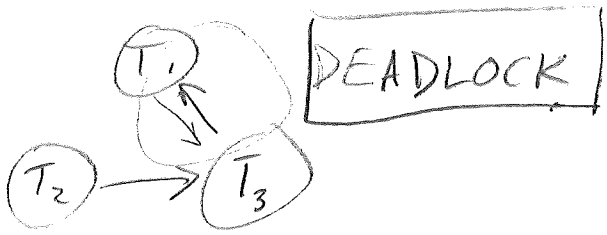


cycle: DEADLOCK

④ Deadlock Detection - Sequence 2

$W_3(A)$; $r_2(A)$; $W_2(A)$; $r_1(B)$; $r_3(B)$; $W_3(B)$; $W_1(B)$

T_1	T_2	T_3
		x|(A); w(A)
s|(B); r(B)	s|(A) Denied wait for T_3	
		s|(B); r(B)
		x|(B) DENIED wait for T_1
x|(B) DENIED wait for T_3		



⑤ Timestamps & Mult Vers.

① $TS_1 = 100$; $TS_2 = 101$; $TS_3 = 102$; $TS_4 = 103$; $TS_5 = 104$

$W_3(A)$ - not allowed because T_5 is most recent timestamp
Abort T_3

$W_1(A)$ - Not allowed, T_5 is most recent timestamp
Abort T_1

$W_4(A)$ - Not allowed because T_5 is most recent timestamp
Abort T_4

$r_5(A)$ - Allowed because T_5 is most recent timestamp
$RTS(A) = 105$

$r_2(A)$ - Not allowed, T_5 most recent timestamp
Abort T_2

C_1, C_2, C_3, C_4 - ignored because they have been aborted

C_5 - Commit T_5 allowed because most recent TS is in T_5

(5) 2) with commit bit

S_1 - $TS_1 = 100$
S_2 - $TS_2 = 101$
S_3 - $TS_3 = 102$
S_4 - $TS_4 = 103$
S_5 - $TS_5 = 104$
$W_3(A)$ - Not allowed, must wait for T_5 & T_4 to commit
$W_1(A)$ - Not allowed, must wait for $T_{2,3,4,5}$ to commit
$W_4(A)$ - Not allowed, must wait for T_5 to commit
$r_5(A)$ - Allowed because T_5 is current TS.
RTS(A) = 105, A.commit = false
$r_2(A)$ - Not allowed, must wait for $T_{3,4,5}$ to commit
$C_{1,2,3,4}$ - ignored, wait for C_5
C_5 - commit, retry T_4 actions A.commit = true
$W_4(A)$ - Allowed because T_5 committed. A.commit = false
WTS(A) = 106
C_4 - commit T_4, retry T_3 actions. A.commit = True
$W_3(A)$ - Allowed because $T_{4,5}$ committed. A.commit = false
WTS(A) = 107
C_3 - commit T_3, retry T_2. A.commit = True
$r_2(A)$ - Allowed because $T_{3,4,5}$ committed. A.commit = False
RTS(A) = 108
C_2 - commit T_2, retry T_1. A.commit = true
$W_1(A)$ - Allowed, $T_{2,3,4,5}$ committed. A.commit = false
WTS(A) = 109
C_1 - commit T_1. All transactions committed & finished

(5) 3) multiversion TS

S_1, S_2, S_3, S_4, S_5 - $TS_1 = 100$, $TS_2 = 105$, $TS_3 = 110$, $TS_4 = 115$, $TS_5 = 120$

$W_3(A)$ - write $A(110)$. $WTS(A_{110}) = 125$

$W_1(A)$ - write $A(100)$. $WTS(A_{100}) = 130$

$W_4(A)$ - write $A(115)$. $WTS(A_{115}) = 135$

$r_5(A)$ - read $A(120)$. $RTS(A_{120}) = 140$

$r_2(A)$ - read $A(105)$. $RTS(A_{105}) = 145$

C_1 - commit T_1 with $A(130)$

C_2 - commit T_2 with $A(145)$

C_3 - commit T_3 with $A(125)$

C_4 - commit T_4 with $A(135)$

C_5 - commit T_5 with $A(140)$

```
<!--
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CSCI e66
PS 3

6. A schema for an XML database
 -->

<!ELEMENT book-data (author+, book+, wrote+)>
<!ELEMENT author (name, dob?)?
<!ATTLIST author
    authorid ID #REQUIRED>
<!ELEMENT name (#PCDATA)>
<!ELEMENT dob (#PCDATA)>

<!ELEMENT book (title, publisher, num_pages)
<!ATTLIST book
    isbn ID #REQUIRED
    genre #PCDATA "fiction">
<!ELEMENT title (#PCDATA)>
<!ELEMENT publisher (#PCDATA)>
<!ELEMENT num_pages (#PCDATA)>

<!ELEMENT  wrote ()>
<!ATTLIST wrote
    authorid IDREF #REQUIRED
    isbn IDREF #REQUIRED>
```